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ANIMAL SCIENCE

Threatened birds, climate change, and human footprint: protected areas network in Neotropical grassland hotspot

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Abstract: Climate change (CC) and human footprint (HF) shape species spatial patterns and may affect the effectiveness of Protected Areas (PAs) network. Spatial patterns of threatened bird species of Subtropical–temperate hotspots in Southeastern South American grasslands are relevant biodiversity features to guide conservation policies. However, the PAs network covers less than 1% of grassland areas and does not overlap areas with the most suitable environmental conditions for threatened birds. Our aim was to find the most environmentally suitable areas for both current and future threatened birds (2050 and 2070) in Entre Ríos. We applied Systematic Conservation Planning protocols with Ecological Niche Models (ENMs) and ZONATION using distribution interaction function and HF as a cost. Then we overlapped binary maps to find priority areas among time periods. HF showed a more fragmented spatial configuration. The PAs network may include environmentally suitable conditions for threatened birds in CC scenarios and HF. We found areas that showed more connectivity in landscape prioritization over time and ensure high-quality environmental conditions for birds. We concluded that the effectiveness of the PAs network could be improved by overlapping priority areas. Our approach provides a knowledge base as a contribution to conservation-related decisions by considering HF and CC.

Key words: climate change, human footprint, overlapped areas, protected area network, threatened birds.

INTRODUCTION

Biodiversity loss is one of the main topics of global concern (Ceballos et al. 2015). Climate change (CC) and human footprint (HF) produce a synergistic effect on biodiversity loss and these effects will continue in the future (Borges & Loyola 2020). Bird species often respond to climate change according to niche conservatism: when environmental conditions no longer match current species environmental tolerance, species need to change their spatial patterns (Triviño et al. 2018) and this may lead to modifications in the representativeness and effectiveness of the Protected Areas (PAs) network (Thomas & Gillingham 2015). Geographical distribution of species is one of the main biodiversity features that may enhance the representativeness of a PAs network (Arzamendia & Giraudo 2012). Moreover, PAs do not often overlap with current biodiversity hotspots, especially in South America (Soutullo & Gudynas 2006). Currently, they are established in pristine habitats generally surrounded by highly modified landscape matrices (Thomas & Gillingham 2015). However, these areas may not overlap with those spatial patterns of endangered species (Cristaldi et al. 2019). The attributes of PAs networks may be enhanced by introducing scientific criteria into their planning and management (Giraudo et al. 2003).

Spatial conservation prioritization allows analyzing distributions of various classes of biodiversity features and HF, such as threats, land cost, and opportunity costs for stakeholders (Moilanen et al. 2005). Ecological Niche Modelling (ENM) allows finding association patterns among environmental variables and species occurrence and can provide useful ecological insights about species distribution dynamics over time (Soberón & Peterson 2005).

Subtropical temperate hotspots of Southeastern South American grasslands (SESA Grasslands) in the province of Entre Ríos encompasses important bird areas (IBAs) that are threatened and overlap with the spatial distribution of endemic grassland birds (Azpiroz et al. 2012). SESA Grasslands are subject to some activities that cause habitat transformation and bird population decline, such as hunting, intensive agriculture and livestock (Giraudo et al. 2003). In this context, the establishment of PAs can provide for threatened species, thus playing a significant role in the conservation of regional biodiversity (Arzamendia & Giraudo 2012). However, the PAs network in SESA grasslands was established for opportunistic reasons (e.g. nonproductive areas, landscape beauties, availability of fiscal lands, flood lands) and covers less than 17% of grassland surface, which is the minimal threshold suggested by Aichi Biodiversity Target 11 (Juffe-Bignoli et al. 2014, Azpiroz et al. 2012 further revision). Also, most remnants of large grasslands are devoted to livestock and native grasslands are threatened by inappropriate management (Bilenca & Miñarro 2004). Since the province of Entre Ríos still present natural patches with threatened bird populations that should be protected, spatial conservation prioritization might contribute to enhance the current PAs network.

Therefore, our aims were: (1) to model the ecological niche of 17 threatened bird species that inhabit SESA grasslands; (2) to assess the current PAs network in the province of Entre Ríos in relation to the current and future coverage of the most environmentally suitable areas for grassland bird species; and (3) to identify priority areas for PAs network expansion in order to enhance its representativeness and effectiveness for threatened birds over time.

MATERIALS AND METHODS

Study area

The province of Entre Ríos (Argentina) has a surface of 78,781 km^2, bordered by the Guayquiraró River to the north and Basualdo Stream, Mocoretá River, and Las Tunas Stream to the South, by the Paraná River to the West, and by the Uruguay River to the East (Di Giacomo & Krapovickas 2005). Entre Ríos encompasses four phytogeographical regions: Paranaense by the Uruguay River; Delta and Islands of Paraná River; Humid Chaco (all dominated by subtropical and riparian forests and wetlands); and Mesopotamic and Pampas grasslands, all being part of SESA grassland hotspot, which occupies most provincial surface (savannas, grasslands, and temperate open dry forests and shrublands called 'Espinal') (Di Giaccomo & Krapovickas 2005, Azpiroz et al. 2012) (Fig. 1).

Records of species occurrence

We found 17 threatened bird species according to the criteria established by the International Union for Conservation of Nature (IUCN 2020). We obtained 1494 records (range of sample size: min=24 and max=200, see Supplementary Material – Table SI). Occurrence data were obtained from: (1) museum collections; (2)

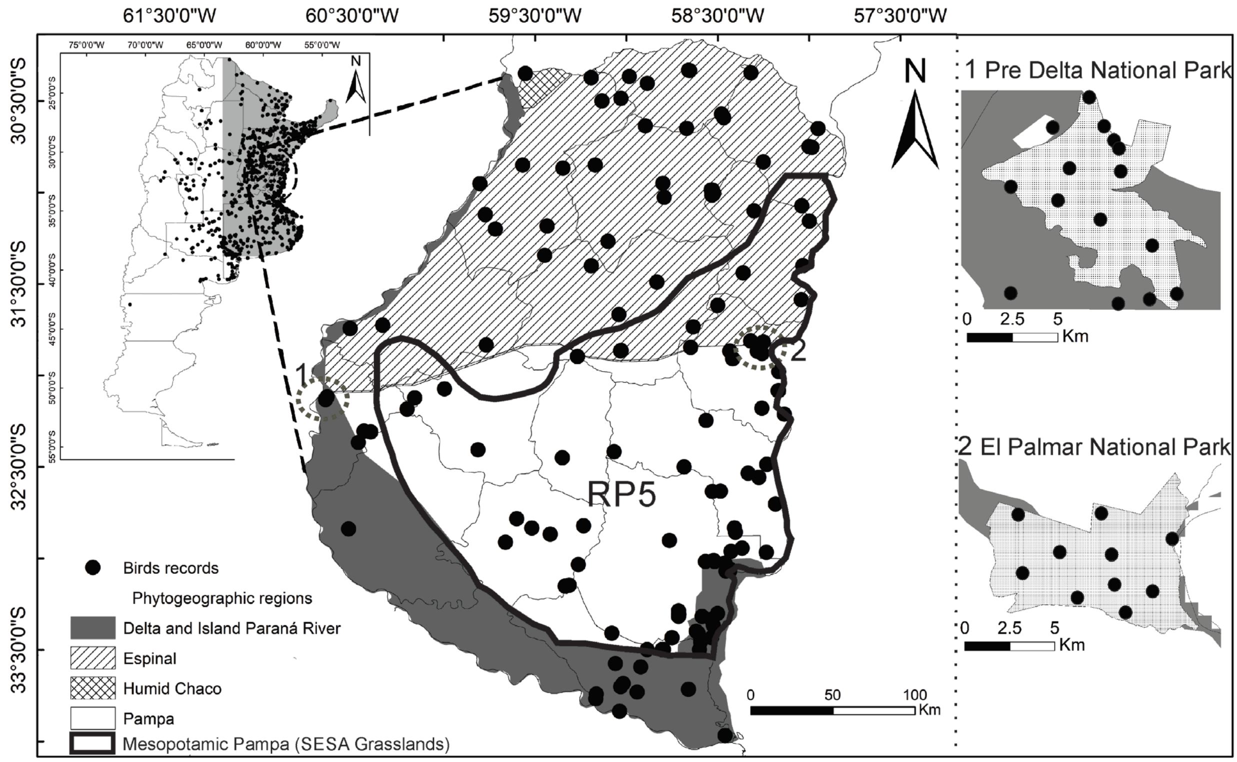

Figure 1. Map of Argentina and the province of Entre Ríos. The background being used is shown on the left upper corner of the map of Argentina (gray area). Black dots represent the records of threatened birds that inhabit Entre Ríos. Numbers (1 and 2) represent the Protected Area Network.

scientific literature published from 1868 to 2020; (3) online data bases: (I) Sistema Nacional de Datos Biológicos (*Argentine Biological Data System*) (www.sndb.mincyt.gob.ar); (II) eBird (http://ebird/content/Argentina); (III) GBIF (www.gbif.org); (IV) Xenocanto (http://www.xeno-canto.org); (V) Ecoregistros (www.ecoregistros.org); and (4) 392 field work carried out between 1989 and 2018 throughout the country (Table SI). We only used georeferenced records with evidence (vouchers, photos, and bird singing records). We selected a background beyond the boundaries of the province of Entre Ríos including most of the distribution range of species for the following reasons: (1) scattering plays a crucial role in species distribution (Barve et al. 2011); (2) large backgrounds reduces the likelihood of biases due to historical events in the parametrization of ENM (explained below) (Owens et al. 2013); (3) we have a representative database at this spatial scale with 350,000 records (Zeng et al. 2016); (4) this background includes accessibility areas of the studied species (part "M" of BAM diagram in Soberón & Peterson 2005); and (5) the area is bounded by the Paraná and Uruguay Rivers and overlapped with the SESA grasslands and savannas inhabited by the studied species (Arzamendia & Giraudo 2012, Azpiroz et al. 2012). We obtained a digital map of the current PAs network of Entre Ríos from UNEP-WCMC & IUCN (2021). We only considered those PAs included in categories I-IV of the IUCN (Dudley, 2008). Under this requirement, the PAs network currently covers 0.14% of the province (Fig. 1).

Environmental data

We used 19 climatic variables from WorldClim (http://www.worldclim.org/bioclim) for current and future conditions (2050 and 2070) and one topographical variable (altitude) obtained with R-package raster, with 2.5 x 2.5 arc-minute spatial resolution for South America (Hijmans et al. 2005). We assessed the effect of climate change on threatened bird species distribution using the Representative Concentration Pathways (RCP) 6 (van Vuuren et al. 2011). The RCP 6 simulate climate system responses to increasing levels of green-house gases based on projected human population size, technological advances, and socio-economic trends with moderate changes in climate (Ferretti et al. 2018). A projection of climate change for 2050 and 2070 was used according to three Global Circulation Models (GCMs): The Community Climate System Model 4 (CCSM), the Hadley Centre Global Environmental Model 2 (HCGE), and the Coupled Model version 4.0 of Pierre Simon Laplace Institute (IPSL). Such models describe the atmospheric physics and dynamics and are used to simulate the global atmospheric circulation and provide weather forecasting (Krechemer & Marchioro, 2020). Also, these GCMs have been widely used in previous studies conducted in regions that overlap our study area (Maenza et al. 2017, Velazco et al. 2021). Besides, they have been used to assess the spatial distributions of many species according to CC, ecosystems, and other long timescale components of the earth, including the simulations of the currently available RCPs (Santana et al. 2019).

To avoid overfitting, we reduced the total set of determinants by dropping collinear variables as follows (Zuur et al. 2010): (1) we carried out a Principal Component Analysis for both temperature and precipitation variables; (2) we selected the variables with the highest loads in the first and second main components; (3) we used the Variance Inflation factor (VIF) to detect collinearity between the retained variables in (2) and altitude. The five selected variables were: Mean Diurnal Range (Bio 2), Mean Temperature of Coldest Quarter (Bio 11), Annual Precipitation (Bio12), Precipitation of Warmest Quarter (Bio 18), and Altitude. We considered all variables in the final set for further analysis since they were not correlated (VIF < 5) (Dormann et al. 2013). We fitted ENMs using all possible subsets of three, four, and five environmental predictors.

Environmental Niche Models

We conducted species-specific tuning of Maxent settings since it proved to be a simpler and substantially more realistic model than those built using default settings (Radosavljevic & Anderson, 2014). Since auto feature in MaxEnt may capture local idiosyncratic effects rather than broad physiological responses of species (Syfert et al. 2013), we used linear and quadratic feature classes. Quadratic responses are suitable for unimodal curves, as expected for fundamental niches (Austin 2007). Finally, we tested 8 values for the regularization multiplier (0.5–4.0 at intervals of 0.5) and different combinations of the previously stated set of environmental variables. We randomly selected 70% of the data (both presence and background) to fit the models and held the remaining 30% for testing purposes, running one replicate per model. We evaluated the candidate model performance based on partial ROC (significance test), omission rates, and model complexity (AICc) (Galante et al. 2018). The best models were selected according to Cobos et al. (2019) using Rstudio (2015): (1) significant models with (2) omission rates ≤5%. From this set, then, we selected those models with delta AICc values ≤2 as final models (Cobos et al. 2019). We fitted MaxEnt models that met all previous criteria for all species except for *Culicivora cuadacuta* and *Sporophila cinnamomea*. The omission rate of the best models for these species were 5.3% and 5.9%, respectively. These values are lower than the 10^{th} percentile presence threshold widely applied in the scientific literature (Radosavljevic & Anderson 2014). Moreover, all models presented high values of partial ROC, and thus they were considered in further analysis.

Then we projected model predictions under future climate scenarios by 2050 and 2070. After that, we transformed ENM predictions into binary outputs using the Minimum Training Presence (MTP) value as a threshold. The MTP included all training presences with a zero-omission rate, a desired result when trying to define suitable areas for threatened species (Marcer et al. 2013). These binary maps were used to determine areas that each species may lose (become unsuitable), gain (suitable), and keep (remain unchanged) in the future with respect to current suitable conditions. Binary maps were drawn using Map Comparison Kit (MCK) 3.2.3 software (Visser & Nijs 2006 http://www.riks.nl/mck). We overlapped binary predictions and we identified agreement/disagreement areas (Visser & Nijs 2006).

Landscape prioritization

We used ZONATION algorithm to identify priority areas for threatened birds in Entre Ríos for current and future conditions (Moilanen et al. 2005). ZONATION generates a hierarchical and nested prioritization of a landscape by removing the least valuable cells from the landscape while minimizing marginal loss of the conservation value (Moilanen et al. 2005). We did not use the background to identify priority areas since the management of natural resources in Argentina are managed by each province. We considered two alternative prioritization criteria that complement each other (Moilanen et al. 2014): (1) core-area ZONATION (CAZ), which emphasizes areas with the highest suitability scores for each species; and (2) the additive-benefit function (ABF), to favor species-rich areas over areas with a high occurrence value for just one or a few species (Moilanen et al. 2005). When compared to CAZ, the ABF method considers all (weighted) feature proportions in each cell instead of only one feature that has the highest value (Moilanen et al. 2014). As a result, we may have a more connected landscape prioritization but this does not necessarily mean that those areas are better for each target species (Moilanen et al. 2014). Furthermore, we used the distribution interactions component of ZONATION to find areas that overlap with current and projected future conditions (Rayfield et al. 2009). This component transforms the distribution of one conservation target (current distribution) according to its proximity to the distribution of another conservation target (future distribution) and provides high values where both distributions overlap (Carroll et al. 2010). We parameterized the interaction between current and future distribution as a positive value because it is possible to identify priority areas that are currently valuable and may coincide with the expected future distribution areas for bird species (Carroll et al. 2010). We considered the Human Footprint (HF) as ‘cost’ because threatened birds in Entre Ríos are affected by HF (Wildlife Conservation Society 2005). We performed the analysis with CAZ and ABF considering two different scenarios: (1) one included all ENM predictions for all threatened bird species and the current PAs network (CAZ 1 and ABF 1, respectively), and (2) the other one consisted of scenario 1 including HF (CAZ 2 and ABF 2, respectively).

To show consensus areas among priority areas for the GCMs, we reclassified each ZONATION landscape prioritization on a binary map, using the first 17% as a threshold (from 0 to 82.99% and 83% to 100%) and we overlapped them using Map Comparison Kit (MCK). The purpose was to find out if the province could still meet the Aichi Biodiversity Target 11 for threatened bird species and to identify the representativeness and effectiveness of the PAs system of the province over time.

RESULTS

Environmental data and predictors

The analysis selected 16 subsets with combinations among three and five of 19 environmental predictors and the altitude to model environmentally suitable areas for species. Bio 18 (Precipitation of Warmest Quarter), Bio 2 (Mean Diurnal Range), Bio 11 and 12 (Mean Temperature of Coldest Quarter and Annual Precipitation respectively), and altitude are among the main environmental predictors for most species. All significant ENMs presented a low omission rate since it was lower than the 10th percentile for all species and lower than the 5th percentile for most of them. Therefore, we included all species in the spatial prioritization (Table SI).

Species distribution models

Results showed that some of the current environmentally suitable areas for all species will remain. On the other hand, we observed substantial changes in spatial patterns of environmental suitability for all species in the different GCMs. All of them, however, will keep areas with their current environmentally suitable space within the province. *Asthenes hudsoni, Limnoctites rectirostris, Spartonoica maluroices,* and *Sporophila ruficollis* might lose more than 25% of their current environmentally suitable areas according to some GCMs. *Alectrurus risora*, *Calidris subruficollis, L. rectirostris, S. maluroides, S. hypochroma, and S. ruficollis* might keep less than 50% of their current environmentally suitable conditions; the remaining species will maintain more than 50%. Finally, *A. risora, C. subruficollis, Eleothreptus anomalus* and *Sporophila palustris* might gain 40% of their current environmentally suitable conditions in new areas. All species showed highest values of environmentally suitable conditions in riverside areas. Specifically, *A. risora, A. hudsoni, C. subruficollis, E. anomalus, Polystictus pectoralis, Rhea. americana, S. maluroides, S. cinnamomea, S. hypochroma, S. palustris, S. ruficollis,* and *Xanthopsar flavus* showed the highest values of environmentally suitable conditions in both Paraná River and its Delta and Uruguay River by 2070 (Fig. 2 and Figure S1). *Culicivora caudacuta, Gubernatrix cristata, Sturnella defilippii and Xolmis dominicanus* showed highest values of environmentally suitable conditions only in the Uruguay River, and *L. rectirostris* did so in the Delta of the Paraná River (Figure S1).

Spatial conservation prioritization

The PAs network of Entre Ríos does not overlap with the most environmentally suitable areas for threatened bird species for present and future. Also, no differences were found in the spatial prioritization when including the current PAs network in the analysis. The Delta of the Paraná River and the Lower Uruguay River always reached the first 17% of the landscape prioritization, showing high conservation scores (Fig. 3 red areas and Figure S2). North areas reached the highest conservation scores only in CAZ 1. The center region never reached priority scores. Priority areas are mainly concentrated in the south of the province. Overall, priority areas might change their position from the northwest to the southeast by 2050 and 2070 even though Paraná and Uruguay Rivers always reached the first 17%. Priority areas overlapping shows landscape connections between the Delta of the Paraná and Uruguay Rivers, and both might maintain suitable conditions for birds in future.

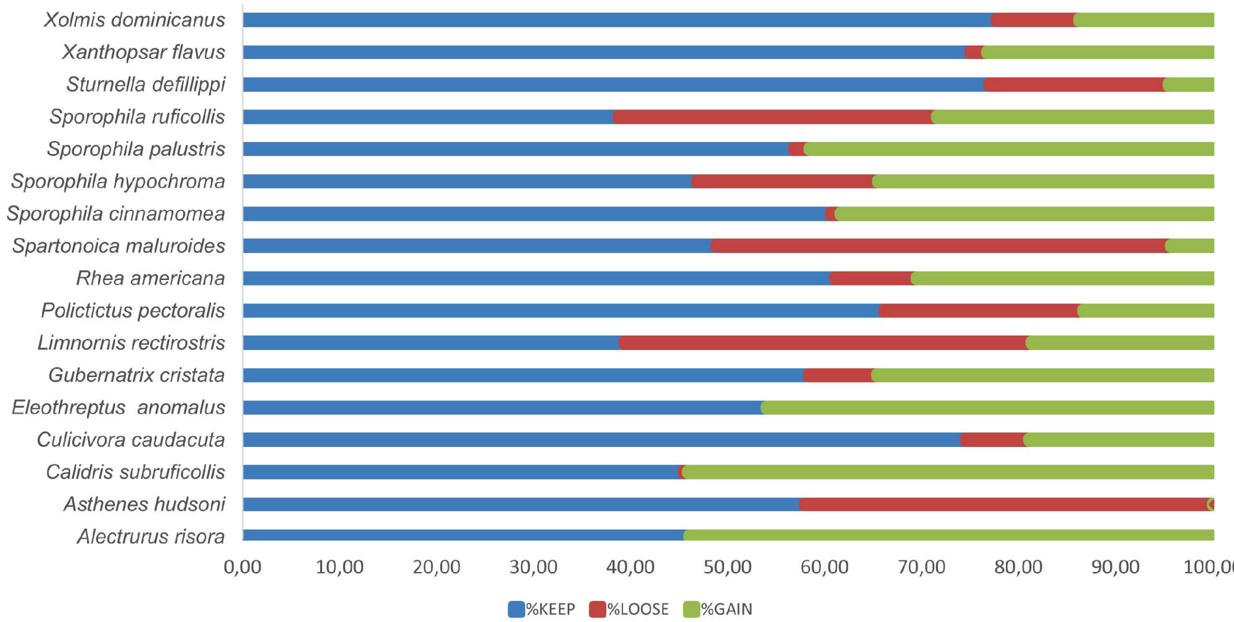

Figure 2. Bar plot showing the average percentage of environmental suitability that each species wins, lose, and keep between current predictions and the average of future predictions.

Unfortunately, no priority areas connect the northern with the southern region (Fig. 3).

Human Footprint substantially affected those priority areas selected in CAZ 2 and ABF 2 with a more fragmented spatial configuration, i.e. there was a larger number of patches with different sizes and shapes and a larger perimeter mainly located in the Delta of the Paraná River and in the north (Fig. 3 and Figure S2).

Priority areas present a wider variation across removal rules (CAZ and ABF) than GCMs and the different periods. CAZ 1 showed important areas in the north and south along the boundaries of rivers. CAZ 2 showed a shift to the north/center, excluding the Paraná and Uruguay Rivers in the north as priority areas. ABF 1 selected the southwest corner and areas along the Uruguay River. CAZ 2 showed a thinning of priority areas in the north over time: it will almost disappear as a priority area in ABF 2 (Figure S2) but it will remain being a priority area in CAZ 2 even though with a substantial surface reduction.

DISCUSSION

Our results show that Climate Change turns some areas environmentally unsuitable and causes some others to become suitable for threatened birds in Entre Ríos. As a pattern, suitable areas will switch from the north to the south and from the west to the east. Also, environmental suitability in some areas will remain almost unchanged in the future and, consequently, the province will be able to offer shelter for threatened bird species in the future. These refuges offered by priority areas present a balance between CC, HF, and threatened bird species persistence over time. We found priority areas using both removal rules (CAZ and ABF), which are necessary to improve the current PAs network. Furthermore, the distribution interactions component of ZONATION shows more aggregated priority areas with local habitat quality for all bird species. On the other hand, overlapped maps display potentially important areas even in 2050 and 2070. These two methods expose a simplified way to understand a possible pattern among

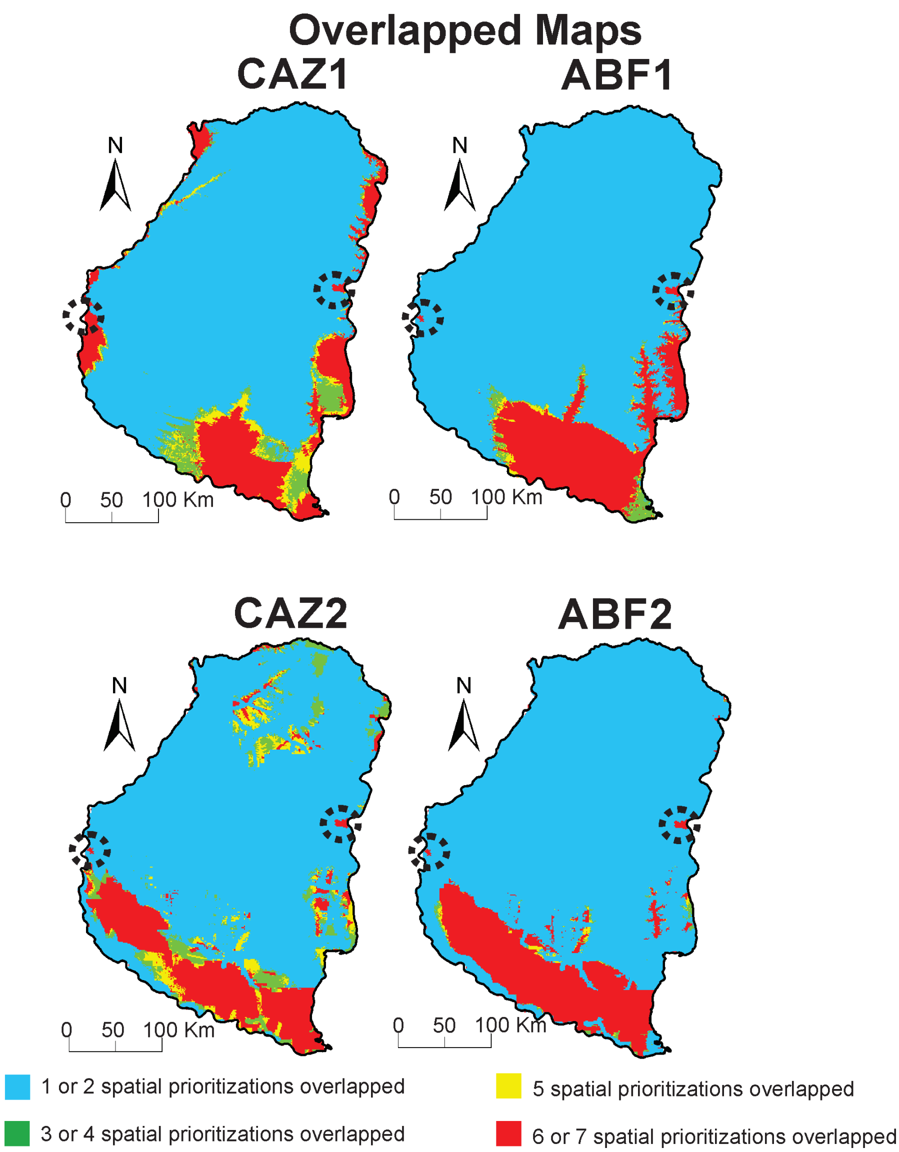

Figure 3. Spatial prioritization areas for the threatened bird species that inhabit Entre Ríos province considering years 2050-2070 and Global Circulation Models. PAs are represented in black dotted circles. Areas with more overlapped spatial prioritizations are shown in red; those with less overlapped spatial prioritizations are shown in blue and those with intermediate scores are depicted in green and yellow. CAZ 1: it includes the overlapped spatial prioritizations obtained with Core Area Zonation and Protected Areas Networks. CAZ 2: it includes CAZ 1 but obtained with Human Footprint. ABF 1 and ABF 2 are like CAZ 1 and CAZ 2 respectively but with Additive Benefit Function (ABF).

suitable areas for species, CC, and HF, which helps stakeholders to make decisions on which areas must be protected.

Species distribution models

Climate change may affect the spatial patterns of environmentally suitable areas for threatened bird species and, consequently, the latter may respond by changing their distribution in their search for new sheltering places (Triviño et al. 2018). Although our models predicted suitable environmental conditions for species by 2050 and 2070, we found differences in bird responses. For instance, *A. risora* and *L. defilippi* may gain suitable areas in Entre Ríos where they used to inhabit in the past and disappeared because of agricultural expansion (Di Giacomo & Krapovickas 2005). Both species show marked niche conservatism, so they will change their spatial patterns (almost 50%) when trying to find shelter (Borges & Loyola 2020). Entre Ríos still presents natural grassland patches in the north and in the east; therefore, both species may still find sheltering areas to inhabit. The Uruguay

River and its intersection with the Delta of the Paraná River presented high suitability scores for *Sporophila cinnamomea, S. hypochroma, S. palustris, X. flavus* and *X. dominicanus* (Fig. 3, Figure S1, S2 for a revision). The Uruguay River covers a variety of habitats that can be used by these species, such as wetlands with humid grasslands, savannas, and forests. In Entre Ríos, species of the genus *Sporophila* inhabit grasslands and wetlands mainly affected by agricultural expansion over their habitats (Thompson et al. 2013). Entre Ríos present priority areas that overlap with SESA grasslands in the south (Delta of the Paraná River) and in the north (Selva de Montiel) for all threatened species of the genus *Sporophila;* thus, they should be considered in future management decisions (Fig. 1 and 3). Predictions for *X. flavus* and *X. dominicanus* showed highly suitable areas in the southern areas of SESA grasslands (as stated by Azpiroz et al. 2012, Di Giacomo & Kaprovickas 2005). Moreover, SESA grasslands are affected by CC, especially in relation to seasonal precipitations. More extreme precipitation events change the natural variability of seasonal precipitation (Grimm 2011) and, therefore, can further affectthreatened bird species. This could be the reason why four in five climatic variables used to construct model predictions were related to precipitation even though there is a wide variety of predictors that must be consider to model species distribution (see BAM diagram in Soberón & Peterson 2005). However, our priority areas coincide with those obtained with alternative criteria in other studies (Arzamendia & Giraudo 2012, Di Giacomo & Kaprovickas 2005, Giraudo et al. 2003, Giraudo & Arzamendia 2018).

Spatial prioritization for conservation

We obtained priority areas for threatened birds with the aim of ensuring current and future conservation. We found that the obtained priority areas with high species richness may underrepresent the spatial distribution of some species such as *A. risora* and *A. hudsoni. C. caudacuta*, *G. cristata*, *R. americana* and *S. ruficollis.* Some species lose environmentally suitable areas in Entre Ríos but gain areas in other provinces or countries. It is important to consider ecological and biogeographical processes rather than political boundaries when making decisions and conducting studies on conservation strategies (Leach et al. 2013). In Argentina, however, each province supervises the management of natural resources within its boundaries, so that conservation policies and strategies in Entre Ríos should be coordinated with those proposed and implemented by neighboring provinces.

The current PAs network of Entre Ríos does not comprise the best environmentally suitable areas for threatened birds and SESA grasslands, which is a common situation in Argentina, where PAs were established for opportunistic reasons, without scientific criteria and planning (Giraudo et al. 2003). In fact, only 5% of grassland regions in South America is protected under IUCN categories I–IV with scientific criteria (Soutullo & Gudynas 2006).

Trade-offs between spatial patterns of species and HF must be considered to improve the current PAs network and minimize conflicts with anthropogenic uses (Dorning et al. 2015). Spatial patterns of HF affected the spatial prioritization process and thus we obtained a priority area network with a more fragmented spatial configuration (Suri et al. 2017). Even though HF pushes priority areas to other sites, it is important to account for human activities to solve human–nature conflicts (Dickman 2010). However, the biggest selected patches overlapped 'Selva de Montiel' -the only IBA of the north- in both time periods. Although this region did not present the most environmentally suitable areas for birds, it might offer shelter and food for threatened birds, which turns it a key region to be conserved (Dardanelli et al. 2018). The selection of the Delta of the Paraná River and the Lower Uruguay River as priority areas may offer great conservation opportunities for threatened birds. Moreover, other findings in the region showed important areas for snakes and proposed these rivers as corridors (Arzamendia & Giraudo 2012, Giraudo & Arzamendia 2018).

We observed that the distribution interactions component of ZONATION provides results considering niche conservatism, since it shows high values on overlapped areas with present and future conditions. This is mostly expected in birds that tend to conserve their niches (Triviño et al. 2018). Also, the province of Entre Ríos do not present geographical barriers that could affect the bird species under study. The Paraná and Uruguay Rivers favor accessibility and displacement for birds and other species acting as biological corridors (Arzamendia & Giraudo 2012). Hence, considering the distribution interactions component function of ZONATION allows for a more reliable reflection of the possible effect of CC on threatened bird species of Entre Ríos. We found that map overlapping using Map Comparison Kit is a useful tool that provides reliable results and shows more connected landscapes. It provides the possibility of understanding slipping patterns of CC and HF. This allows the scientific community and stakeholders to identify important areas that remain ‘unalterable’ and/or fixed like APs, or the Delta and islands of the Paraná River.

On the other hand, there are other predictors affecting population distribution, and thus stakeholders and decision makers must consider this biological approach and all social parties should be involved in the conservation process. Therefore, depending on the area and species, it would be necessary to (1) consider reintroduction programs for *A. risora* and *S. defilippi* (Smeraldoa et al. 2017); (2) mitigate antropogenic systems and agricultural land use for all species but especially for *Sporophila* groups, *X. flavus* and *X. dominicanus*; (3) select corridors for species such as example *Calidris subruficollis, L. rectirostris, Polystictus pectoralis,* and *Spartonoica maluroides* (Suri et al. 2017); and (4) include social factors and education in order to effectively solve human-wildlife conflicts (Dickman 2010) and mitigate the effects of CC on threatened species distribution.

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SUPPLEMENTARY MATERIAL

Figures S1, S2.
Table SI.

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Juan Andrés Sarquis: Collected the data, conceived the ideas, designed the objectives, analyzed the data, results, figures, and maps and wrote the manuscript. Alejandro Raúl Giraudo: Conceived the ideas, reported information about the natural history of species, analyzed the results, and wrote the manuscripts. Maximiliano Ariel Cristaldi: Collected the data, analyzed the data, and made suggestions for manuscript improvement. Vanesa Arzamendia: Performed the data base, provided information about the study site, made the distribution maps of species, and determined the nodes and track and wrote the manuscript.